ULTRASONICS: TECHNOLOGY VS. TOOLS

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Food and material losses to rodents are as old as the knowledge of humans to store food for future use. Humans have had to share their food supplies and learn to live with the unwelcome guests since time immemorial. Even to this day rodents continue to claim a significant share of human food supply on this earth. They have inflicted epidemics that have destroyed large segments of human populations in various parts of our world, throughout history.

They have been responsible for closing down small and large companies in modern times. And even today you will find numerous occasions where a rodent would lodge itself into a carton and ride to a customers' location and thus kill that valuable source of revenue for the host.

The age-old techniques of baits, traps, glue boards, etc. have not worked perfectly, and cannot do a thorough job in many situations. Cases are now abundant where colonies of rodents have developed tolerance to toxicants as well. The reasons for failure are simple. The major drawback of most traditional control methods (or TCM's for short) is that they are attraction oriented, and can only be applied linearly, and only in two dimensions. Thus the TCM's are competing with the available food supply. Usually, the food supply is abundant and the control methods, by their very nature have to be limited. Also the food is often quite nutritious. The TCM's are not.

Under these circumstances the rodents learn to bypass or overcome the controls and get to the food supply. Often they lose a few of their kin to controls, but then they seem to know how to make up for such losses, perhaps by accelerating reproduction. The species continues to survive at levels consistent with the available food supply, and become wiser in the process.

During the past few decades, an interesting phenomenon has been observed. We saw the arrival of the jet age. With that, workers were exposed to high intensity ultrasonic waves generated by the rotating blades of the jet engines. The intensity of ultrasonic sound from these engines is usually 120 to 160 decibels or more. To give you an idea of the meaning of 120 to 160 dB intensity, as an example, if a man were exposed to such a sound in his hearing range then he would become deaf in a very short time. Concern for human safety called for intensive study of the effect of high intensity ultrasonic waves on humans. And that lead to the study of its effects on rats and mice, the usual test animals.

Contrary to expectations in labs, it was observed that rats and mice reacted to high intensity ultrasonic waves quite differently than did humans. These test animals exhibited an extremely high sensitivity to certain ranges of ultrasonic frequencies to which humans had none.

Since then a great deal of research has been done on the hearing capabilities of humans and rodents. Let us now examine some of the most significant findings.

Before we start our examination, let us understand sound clearly. Sound has two inseparable but distinctly different components. Frequency and intensity. The frequency is the number of sound waves that would pass a point in one second. The frequency is measured in Hertz or Hz for short. Thus one Hertz means one wave in one second and one kilo Hertz (kHz) means 1000 waves passing a point in one second and so on.

The intensity is the power, pressure or energy in the wave. It is measured in decibles or dB's for short. You would hear words at 80 dB's or 90 dB's or 150 dB's. That refers to the intensity or power in the sound wave. The decible scale is a logarithmic scale, i.e., it measures the ratio of the intensities. Do not confuse it with the linear scale.

Now we are coming to a very important point which you must always keep in mind. Unless both intensity and frequency are properly defined for any sound the effect of which is being tested in a laboratory, the results would be utterly meaningless. There are examples of research and publications which have missed this simple point and thus they have delivered garbage to the innocent public. They are guilty of creating a great deal of confusion. You must know both, intensity and frequency, to understand sound and its meaning.

Now let us examine human hearing patterns. Contrary to what most may believe, our hearing is neither simple nor a straight line. Our feeling of hearing varies with both frequency and intensity. If you examine the human feeling curve for sound, you will observe that as you go below 4 kHz, the sound has to have more and more intensity to give the same feeling. However, we are deaf to sound below 20 Hz. Similarly, as you go above 4 kHz, the sound must have more and more intensity to give the same feeling. There again most of us are deaf to sounds beyond 19 kHz. That is also why sound above 20 kHz is called ultrasonic. It means it is above the human hearing range.

Thus our hearing range is only between 20 Hz and 30 kHz frequencies and our feeling curve is optimal, or most sensitive, to sounds between 3-4 kHz. In this 3 to

4 kHz range we can hear the most feeble sound and we are most sensitive. Our speech patterns are well below this optimum. Our day to day conversation is carried out in much lower frequencies. Curiously, it has been observed that the sound strength of our conversational frequencies, if delivered in 3 to 4 kHz frequencies range, could become quite intolerable. And a little more power in that range, which is above 85 dB, would drive us out of the room, lest we damage our ears. You would prefer to avoid a room which is filled with 3-5 kHz frequency sound over 85 dB level. Try it any time as a test.

With this understanding of the human hearing range and the implications of optimal sensitivity range, let us divert our attention to the hearing qualities of rodents. Why are they affected differently by ultrasonic sound in lab tests?

Fortunately, modern electronic technology has allowed us to examine the hearing curves of most animals at various frequencies and intensities. Interestingly, the hearing curves of rats and mice are quite revealing. First, they are more sensitive to ultrasonic frequencies than to sonic, though they can hear sonic frequencies also. Secondly, they have two optimal ranges. One range of maximum sensitivity lies in the vicinity of 20 kHz ultrasonic sound and the other in the vicinity of 50 kHz. As you go beyond on both sides of their peak frequencies, the effect is similar to that of humans. The sensitivity drops markedly. Thus we see a gap between the ranges of humans and rodents.

It is this *gap* between the sensitivity range of humans and rodents, namely human deafness beyond 19 kHz and rodent optimal sensitivity around 20 kHz and 50 kHz, that forms the scientific basis of the technology of ultrasonic rodent control.

Obviously, feeble sound, even at these optimal ranges, would not bother rodents, just as similar weak sound in 3 to 4 kHz range would not bother humans.

However, it has been observed that sounds over 85 dB of intensity in these ranges have a significant deterrent effect on rodents in their natural environment. What it means is that where rodents have freedom of movement, they have stayed away from areas that were covered by ultrasonic waves of 85 dB or higher intensities, at these peak frequencies. They were not affected by the same sound where intensity fell below 85 dB.

Fortunately, for the first time in the history of humankind, in our fight with our age old enemy, we have a technology which is repulsion oriented, which keeps rodents away if applied properly. It repels them. Additionally, (unlike TCM's which only cover the two dimensional floor areas), this is a three dimensional system. It covers space. It keeps food or materials out of reach of rodents. It can be applied in such a way that it surrounds the materials to be protected. In more sophisticated applications it could be used to create a fort-like barrier to keep rodents away from a defined territory. Above all, it does not compete with the food supply. It complements it and protects it.

But "technology" is only an abstract method of achieving the practical purpose.

You always need a "tool" or an appliance with which the technology can be applied to achieve the results. Obviously, if the tool has design defects, or if it is not able to deliver the technology for which it is supposed to be designed, you will say that the tool is faulty. It cannot do the job. But you would not and cannot make any assumptions about the technology by looking at the tool alone.

Yet people often confuse the two. They have a tendency to blame the science because of faulty tools. Unfortunately, that has been the case with the use of ultrasonics. It has not been able to deliver the boon to society that it could. The reasons are simple.

REASON #1 - The tools often look fancy and innocent. One has to spend the money to buy them. So when they do not work, people come to innocent but fast and ignorant conclusion that obviously the technology does not work.

REASON #2 - It has been observed that if a technology is beyond the discipline of some experts, then they too are duped into the dilema of Reason #1. It is a lot easier to sit on the chair of authority and say that the technology itself is faulty than:

1. to take the trouble and study the scientific data behind the new concepts,
2. to put extra work, though hard it may be, to expand the domain of the discipline and knowledge,
3. to first understand and establish the basic and abstract scientific principles behind the technology and then to come out and say why the technology does not or would not work.

REASON #3 - When you combine the power of the media with the statements of such experts, then only God can save the human race. Rats continue to flourish. All kinds of them. And the irony is that a science stays in the dark in the very era we call scientific.

History of humans is replete with infinite examples where fear and preconceived notions have kept humanity out of reach of scientific advancements for not just a few years but for many decades and centuries. Galileo was ridiculed for his observations of the universe. The world was kept flat for many centuries for the convenience of theology. Even to this day some are finding it impossible to cope with the concepts of the theory of evolution. Application of ultrasonics to rodent control is no exception.

For the first time in the history of humankind, science has given us a technology to protect ourselves, our food, machinery, equipment and children from the infestation of rodents, and it operates safely in the

human environment. Science has also given us tools to deliver that technology.

It is now up to you to make proper selection of the tools so that you are not fooled by the fly-by-night operators. Often a simple dB meter can show you the difference between a fair and a faulty tool.

Do not let your lack of knowledge persuade you to inaction. Instead, study this subject and the science behind it. You will be surprised by its phenomenal results. You may revolutionize the methodology of rodent control and you will do a service to humanity.